CUTTING TOOL ASSEMBLY HAVING ATTACHED SPRAY NOZZLE HOUSING

TECHNICAL FIELD

[0001] The invention relates to a cutting tool assembly having a replaceable spray nozzle housing.

BACKGROUND ART

[0002] Cutting tool assemblies for such applications as mining or road milling typically comprise a cutting tool, sometimes referred to as a cutting pick, rotatably mounted within a support block. The support block in turn is mounted onto a drum, chain or other body, typically by welding, which in turn is driven by a suitable drive means. A number of such support blocks carrying cutting tools are mounted onto said drum to continually mine and remove material such as coal, rock, concrete, asphalt or concrete. The material in the earth strata being mined or removed by the cutting tool is pulverized by the cutting picks as each tip is rotated about the drum or chain into contact with the earth strata. The material being pulverized by the impact of the pick explodes in all directions. Some of the pulverized material collides against the support block and other cutting tool structure. The continual collision of pulverized material against the support block during operation causes abrasion and wear of the support block and any other components mounted on or near the support block.

[0003] It is also known to equip a cutting tool assembly with a spray nozzle for spraying fluid onto a cutting tool so as to reduce the potential for ignition of gases encountered during cutting or mining activities, such as coal mining. These spray nozzles mounted on cutting tool support blocks are also beneficial in suppressing dust particles that otherwise would be stirred up into the atmosphere during the operation of the cutting tool. U.S. Patent No. 5,392,870, Chapham et al, and U.S. Patent No. 5,378,048, Parrott, both disclose a water spray nozzle. U.S. Patent No. 5,392,870, Chapham et al, and U.S. Patent No. 5,378,048, Parrott, are both incorporated by reference in their entirety into the instant specification. The discharge nozzles in both Parrott and Chapham are formed in the support block. Damage to the discharge

nozzle outlet can either result in enlarging the opening or alternatively can plug the outlet close. If the opening is enlarged then water flows out of the nozzle at a greater rate, wasting water and causing an undesirable pressure loss in the drum manifold water passages that supply other spray nozzles. On the other hand a potential fire hazard/explosion arises if a discharge nozzle becomes plugged and dust particles are stirred up into the atmosphere during the operation of the cutting tool.

[0004] The support block maintains its usefulness in holding the cutting pick after the discharge nozzle is damaged. Despite this the support block and cutting tool assembly must be removed from the drum and a new support block with a new spray nozzle is attached to the drum. Support blocks are expensive themselves and attaching a new one to a drum is time consuming and disruptive of the mining operation. Typically a replacement support block must be welded onto the drum or chain back at the workshop with precision instruments and tools, significantly hampering the efficiency of the mining operation.

[0005] Rothkegal's U.S. Patent No. 4,978,173 discloses a cutting tool assembly having a holder body and a separate replaceable nozzle housing that is releasably secured by screws to the holder body. The screws on such prior art designs are often loosened on account of the vibrations caused by high-speed rotation of the drum during operation. The nozzle housings becoming damaged and/or lost requiring the mining drum to be shutdown for maintenance. In other instances the screws or bolt heads used to fasten the nozzle housing to the holder body become damaged precluding removal of the screw or bolt and the nozzle housing.

[0006] Siebenhofer et al.'s U.S. Patent No. 5,498,069 discloses a cutting tool assembly including a spray nozzle in a bore of the support block adjacent to the cutting tool. When the support block is sufficiently worn away, it can no longer house the nozzle. Additionally the water passages disposed in Siebenhofer et al.'s support block for providing water to the nozzle are configured such that they cannot be drilled out once the pick support box is welded to a drum. As a result, when the passages become blocked, such as by calcium deposits, the cutting tool assembly is no longer useful for cutting operations that require a functioning spray nozzle.

[0007] The spray nozzle housing is intended to spray water adjacent the cutting tool during the useful life of the other structure of the support block. It would be advantageous to have a support block that can be easily fixed by having a spray nozzle housing that is easily replaced. It would be advantageous to have a support block with a spray nozzle wherein the spray nozzle can be manually fixed, with a leak-free joint, to the support block in the field.

DISCLOSURE OF THE INVENTION

[0008] It is an object of the invention to provide a new and improved cutting tool assembly having a support block and a replaceable spray nozzle housing mounted to the support block, wherein the spray nozzle housing is simple in design and relatively economical to manufacture.

[0009] In one illustrated embodiment of the invention, the cutting tool assembly comprises a support block having a first cylindrical bore for receiving a cutting tool. The support block also has a replaceable unitary spray nozzle housing, the nozzle housing is generally cylindrical with a flat bottom surface for mounting onto the support block. The nozzle housing has a nozzle outlet formed in a generally circular forward face of the nozzle housing. The spray nozzle housing has a nozzle fluid passage therein for communicating fluid from the inlet in the bottom surface to the nozzle outlet.

[0010] The cutting tool assembly in the illustrated embodiment comprises a support block having first and second outer surfaces and a block fluid passage. The block fluid passage communicates fluid between the first and second outer surface portions of the support block. The replaceable spray nozzle housing is attached to the support block so that the nozzle fluid passage is in fluid communication with the support block fluid passage. The support block passage comprises of two passage portions both having straight-line axes.

[0011] Advantageously, with such straight-line block fluid passage portion configurations the support block fluid passage can be easily manufactured. The straight-line passage portion configurations also permit ease in cleaning debris such as

calcium from the block fluid passages so as to ensure maximum fluid flow therethrough.

[0012] Still another object of the present invention is to provide a design for manufacturing wear reducing components, which are easy to manufacture, install, and which are cost effective for their intended purposes.

[0013] While one embodiment of the new and improved cutting tool assembly is illustrated and disclosed, such disclosure should not be construed to limit the claims. It is anticipated that various modifications and alternative designs may be made without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIGURE 1 is a side view of a cutting tool assembly showing one embodiment of the invention including a support block, a replaceable spray nozzle housing, a sleeve and a cutting tool.

[0015] FIGURE 2 is a cross-sectional view of the support block of the cutting tool assembly of Figure 1 with the cutting tool and sleeve removed taken along lines 2--2 shown in Figure 1.

[0016] FIGURE 3 is a cross-sectional view of the support block of Figure 1 with the cutting tool and sleeve removed taken perpendicular to the view shown in Figure 2 along lines 3--3 in Figure 2.

[0017] FIGURE 4a is a side view of the replaceable spray nozzle housing.

[0018] FIGURE 4b is a bottom view of the replaceable spray nozzle housing.

[0019] FIGURE 4c is a front view of the replaceable spray nozzle housing.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Figure 1 a cutting tool assembly 10 according to the invention for use in mining and cutting operations. The cutting tool assembly 10 includes a support block 12, a replaceable spray nozzle housing 14 connected to the support block 12, a protective tool sleeve 16 that is also removably connected to the support block 12, and a cutting tool 18 disposed within the tool sleeve 16.

[0021] The support block 12 is adapted to be connected to a rotatable drum (not shown) in any suitable manner, such as by welding, so that the cutting tool 18 may be driven into material sought to be removed or mined. The support block 12 has an exterior that includes first and second outer surface portions 20 and 22, respectively. The first outer surface portion 20 remains exposed during use, while the second outer surface portion 22 is concealed when attached to the housing.

[0022] As shown in Figure 3, the support block 12 includes a block fluid passageway 26 having an upstream portion 24 and downstream portion 28. Both portions 24 and 28 are substantially straight; the upstream portion of the block fluid passageway 24 has an inlet opening 25 in the second outer surface 22 where the upstream portion 24 of the passageway intersects the second outer surface. The downstream portion 28 intersects with the first outer surface, where the downstream portion 28 intersects the outer surface portion it forms an outlet opening 27. The upstream portion 24 intersects the downstream portion 28 at sidewall chamber 23. The sidewall chamber 23 is manufactured by drilling a hole into a sidewall of the first outer surface portion 20. The downstream portion 28 and upstream portion 24 of the block fluid passageway are then manufactured by drilling a hole from the sidewall chamber 23 to second outer surface 22 and the first outer surface 24 respectively. Next a plug 21 is inserted into the drilled out section of the sidewall and fixed thereto in a liquid tight fashion by any fastening means well known in the art. The upstream portion and downstream portion can be cleaned of debris without removing the support block from the drum. The plug is first removed during maintenance and next a drill is inserted into both the upstream portion and the downstream portion to clean out any debris, such as calcium deposits, that may be clogging the block passage.

[0023] The first outer surface of the support block in the illustrated embodiment includes an upper portion and lower portion, the support block 12 illustrated in the embodiment of the invention is generally cannon shaped having an upper barrel portion and lower base portion as well-known in the art. It should be appreciated that the invention is not limited to the illustrated embodiment and that it is contemplated that the support block alternatively could have other shapes and geometries.

[0024] The spray nozzle housing 14, as shown in figures 4a-4c, is generally cylindrical and has a central longitudinal axis. The spray nozzle housing 14 has a flat bottom surface 30 oriented at an angle with respect to the central longitudinal axis of the spray nozzle housing. The central axis of the spray nozzle housing is oriented so that the water spray from the nozzle outlet 34 is projected in the direction of the cutting tool tip. In the embodiment shown in figure 4a the angle the bottom surface of the spray nozzle makes with the central longitudinal axis is about 5^0 degrees. In the alternative and depending upon the specific application, the bottom surface may be oriented at an angle within a range of between about 4^0 degrees to about 6^0 degrees. In other instances the angle may be present in a range between about 2^0 degrees to about 20^0 degrees. The spray housing has a main fluid chamber 35 that is in communication with a spray outlet 34. Fluid flows from a main chamber inlet passage 38 into the main chamber 35, the inlet passage 38 is in communication with an elongated fluid recess chamber 36. The elongated recess chamber 36 is formed in the flat bottom surface 30 of the spray housing. The elongated recess forms an inlet that is in fluid commutation with the outlet opening 27 of the support block fluid passage.

[0025] The spray nozzle housing 14 is welded to the first outer surface 20; the cross-hatching shown in figure 1 represents the weld joint. The spray nozzle housing is assembled to the support block 20 by conventional welding methods as are well known in the art. The spray nozzle housing is oriented on the first outer surface 20 of the support block so as to place the spray nozzle housing in fluid communication with the block fluid passage 26 in the support block. The disclosed embodiment includes an elongated recess chamber 32 having an elongated open end inlet that allows for ease in proper alignment of the spray nozzle housing 14 into position so that the outlet opening 27 on the top of the first outer surface 20 of the support block is placed in proper fluid communication with the spray nozzle housing fluid passage. The elongated recess chamber 32 in the bottom surface 30 of the spray nozzle housing allows for greater tolerance in positioning the spray nozzle housing 14 into alignment with the support block outlet 27 as opposed to the precise alignment which would otherwise be necessary if the supply opening into the spray nozzle housing 14 had a cross-sectional area of the outlet opening 27. Although it is not critical for welding

purposes that the cross-sectional area of the open end of the recess chamber 32 as best shown in figure 4b is at least twice the cross-sectional area of the outlet opening 27 on the top of the support block, such a relationship makes it easier to adequately position the spray nozzle housing manually prior to welding. Applicant also contemplates that the cross-sectional area of the open end of the recess chamber 32 alternatively is at least three times the cross-sectional area of the block outlet 27 opening. Applicant further contemplates that the cross-sectional area of the outlet opening is at least four times the cross-sectional area of the block outlet opening. The elongated recess chamber 36 allows a welder to manually replace spray nozzles in either the field or the workshop.

[0026] The shape and geometries of the spray nozzle housing and/or nozzle outlet is not intended to be limited to the disclosed embodiment wherein the spray nozzle housing is generally cylindrical. The applicant contemplates different spray nozzle housings having different shapes and/or sizes that may vary in accordance with different applications, manufacturing costs and/or other considerations. It is contemplated that the spray nozzle housing and support block may have a plurality of different shapes and geometries so long as the cooperating contact surfaces between the spray nozzle housing and first surface of the support block are adapted to form enough contact with each other or to permit the spray nozzle housing and support block to be securely welded together in a leak-free manner. It should be appreciated that the first outer surface 22 of the support block and the bottom surface 30 of the spray nozzle housing may be configured to have any cooperating shape or geometry which are well known in the industry to form a suitable liquid tight seal therebetween. It is contemplated that in an alternative embodiment that the bottom surface of the spray nozzle housing might not be flat but may have for instance have a curvature corresponding to the radius of curvature of the barrel portion of the support block.

[0027] The support block and spray nozzle housing of the application are made from any heat treatable, weldable alloy steel, including SAE 4130,15B37, 4140, 8720, 8740, 8637h or other well-known steels used in the construction/mining industries. In one embodiment the spray nozzle housing is manufactured from heat

treated 4140 steel and the support block is manufactured from heat-treated 8637h steel.

[0028] The spray nozzle housing can be applied to the steel alloy support block by a metallic electro-welding electrode out in the field. During such welding operations the weld is applied to the spray nozzle housing so as to not overheat either the spray nozzle housing and/or support block. The size of the spray nozzle housing is relatively small in comparison to the support block resulting in a greater rate of heat dissipation from the spray nozzle housing relative to the support block, such cooling rate variation can cause thermal stress fractures in the weld joint. Accordingly as well known in the art the weld joint is applied by initially forming a liquid tight weld dam about the fluid connection between the support block and spray nozzle housing. Weld is next applied, without overheating the joint, about the initial weld dam to further strengthen the joint. Throughout the welding process the relative temperature of the spray nozzle housing and support block are controlled as well known in the art so that thermal stress fractures do not occur.

[0029] In the prior art seal means such as O-ring seals were required in the support block to form a liquid tight passage between a liquid supply source and a spray nozzle housing on the support block. See the seal rings on the protective sleeve in U. S. Patent No. 4,678,238 to Emmerich. By welding the spray nozzle housing 14 onto the support block and welding the plug 21 to the support block, no seal rings on the support block or protective sleeve are necessary, and the protective sleeve can be designed solely for the purpose of reducing wear on the support block.

[0030] To assemble the cutting tool assembly 10, the support block 12 is welded to a rotatable drum (not shown) so that the support block fluid passage is in fluid communication with a fluid supply passage (not shown) within the drum. The weld sufficiently seals the support block 12 to the drum in a liquid tight manner. The protection sleeve 16 is then inserted in the barrel bore 11 of the support body. The cutting tool 18 is then inserted into the tool sleeve 16 and secured to the tool sleeve 16 in any suitable manner such as a retainer ring. Next, the spray nozzle housing 14 is positioned so that the fluid recess chamber 36 is in communication with the outlet opening 27 of the support block fluid passage and then welded into position.

[0031] In operation of the cutting tool assembly 10, a supply manifold in the drum communicates water to inlet 25. Inlet 25 communicates with the upstream portion 24 next into sidewall chamber 23 and then the downstream portion 28 of the support block fluid passage. The water exits the support block at the support block outlet opening 27, flows into the recess chamber 36 through the spray nozzle housing and exists the spray nozzle outlet 34 and toward the tip of the cutting tool 18. The water from the spray nozzle outlet reduces the potential for ignition of gases such as methane encountered during cutting or mining activities. The water spray additionally suppresses dust during mining and also helps to lubricate the joint between the cutting tool and sleeve for better rotation of the cutting tool.

[0032] While an embodiment of the invention has been illustrated and described, it is not intended that this embodiment illustrates and describes all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention.